

# Subsurface Basement Modeling and Survey Methods



Eric L. Darois, CHP  
RSCS Inc.



# Topics

- Historical Treatment of subsurface basements for modeling and surveys
- Recent treatment of subsurface basements
- Similarities to subsurface soils
- Proposed considerations for modeling and surveys.

# Historical Case Studies

- Circa 2005
  - Maine Yankee
  - Connecticut Yankee
- Modeling Methods
- Survey Methods



# Maine Yankee

## Modeling

- Basement Fill Model – 3 ft below grade with flowable fill
- Assumed 1mm depth of residual radioactivity on surfaces
- Radioactivity Distribution: Fill, Concrete, water
- Dose Pathways: Drinking Water, Irrigation Dose (Soil/Farming), Direct Dose
- Other Subsurface Sources
  - Buried Pipe
  - Embedded Pipe
  - Deep Soil
  - Groundwater

# Maine Yankee

## Subsurface Surveys

- Irradiated Concrete
  - In-Core Instrument Sump
  - Subjected to Characterization Survey Only
  - Estimated total activity to support Basement Fill Model
    - Gamma Spec of Concrete Cores
    - Selected in-situ gamma spectroscopy
- Other Surfaces
  - LTP allowed for in-situ gamma spec or alternative methods with 30-day advance notice to NRC for review of basis documents



# Connecticut Yankee

## Modeling

- LTP Rev 4
- Subsurface modeling used to derive “Future Groundwater Dose”
  - Basement Fill Model included all basements and embedded pipe: CTMT Mat & Walls, In-Core Sump, SFP, Cable Vault, Switchgear, Discharge Tunnels/Structure, Intake.
- Accounted for Flowable Fill and Grout where applicable

# Connecticut Yankee

## Subsurface Surveys

- LTP Rev 4
- Designed to evaluate volumetric residual radioactivity
  - Concrete Cores Only, Total Min #=84 (Table 5-10) from all structures defined
  - 20% of all cores analyzed for Full Suite (20 radionuclides) including HTDs

# Recent Cases

- Zion and La Crosse – Backfilled Basements
- Modeling
  - Variation of Basement Fill Model Converted to DCGLs
  - Added Excavation Scenario
  - DCGLs considered GW pathways and excavation soils
- Survey Methods
  - Characterization Concrete Sampling
  - In-situ gamma spectroscopy
  - MARSSIM Class 1
  - 100% Coverage (overlapping geometric circular views)
  - Hundreds of measurements required





# Subsurface Structures vs Subsurface Soils

## Structures

- Once backfilled:
  - No Direct Exposure to Surfaces
  - Future GW Pathways
  - Unlikely Large-Scale Excavation Exposures
- Surveys
  - Targeted Characterization Based on Confirmed Elevated Areas
  - No need for 100% Scan Coverage

## Soils

- In-Situ Condition
  - No Direct Exposure to Surfaces
  - Future GW Pathways
  - Unlikely Large-Scale Excavation Exposures
- Surveys
  - Subjective and Iterative
  - 100% Coverage Not Possible or Needed
  - Geostatistical Interpretation

# Proposed Approach to Subsurface Structures

- Modeling
  - Basement Fill, Activity Inventory
  - Applicable Dose Pathways
- Surveys
  - Characterization or Radiological Assessment Techniques
  - MARSSIM Class 1 Criteria Too Restrictive and Not Risk-Informed



# *Questions/Discussions*